



Recommended Postearthquake Evaluation and Repair Criteria for Welded Steel Moment-Frame Buildings

Program to Reduce the Earthquake Hazards of
Steel Moment-Frame Structures

DISCLAIMER

This document provides recommended criteria for the postearthquake damage assessment, evaluation and repair of steel moment-frame buildings. These recommendations were developed by practicing engineers, based on professional judgment and experience, and by a program of laboratory, field and analytical research. It is primarily intended as a resource for communities in developing formal postearthquake damage assessment and repair programs, but may also be used as a resource by individual engineers and building officials, when such formal programs have not been adopted. While every effort has been made to solicit comments from a broad selection of the affected parties, this is not a consensus document. **No warranty is offered, with regard to the recommendations contained herein, either by the Federal Emergency Management Agency, the SAC Joint Venture, the individual Joint Venture partners, or their directors, members or employees. These organizations and their employees do not assume any legal liability or responsibility for the accuracy, completeness, or usefulness of any of the information, products or processes included in this publication. The reader is cautioned to review carefully the material presented herein and exercise independent judgment as to its suitability for application to specific engineering projects.** These recommended criteria have been prepared by the SAC Joint Venture with funding provided by the Federal Emergency Management Agency, under contract number EMW-95-C-4770.

Cover Art. The beam-column connection assembly shown on the cover depicts the standard detailing used in welded steel moment-frame construction prior to the 1994 Northridge earthquake. This connection detail was routinely specified by designers in the period 1970-1994 and was prescribed by the *Uniform Building Code* for seismic applications during the period 1985-1994. It is no longer considered to be an acceptable design for seismic applications. Following the Northridge earthquake, it was discovered that many of these beam-column connections had experienced brittle fractures at the joints between the beam flanges and column flanges.

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SAC Joint Venture

A partnership of
Structural Engineers Association of California (SEAOC)
Applied Technology Council (ATC)
California Universities for Research in Earthquake Engineering (CUREe)

**Prepared for SAC Joint Venture Partnership by
Guidelines Development Committee**

Ronald O. Hamburger, Chair

John D. Hooper	Thomas Sabol
Robert Shaw	C. Mark Saunders
Lawrence D. Reaveley	Raymond H. R. Tide

Project Oversight Committee

William J. Hall, Chair

Shirin Ader	Nestor Iwankiw
John M. Barsom	Roy G. Johnston
Roger Ferch	Leonard Joseph
Theodore V. Galambos	Duane K. Miller
John Gross	John Theiss
James R. Harris	John H. Wiggins
Richard Holguin	

SAC Project Management Committee

SEAOC: William T. Holmes

ATC: Christopher Rojahn

CUREe: Robin Shepherd

Program Manager: Stephen A. Mahin

Project Director for Topical Investigations:

James O. Malley

Project Director for Product Development:

Ronald O. Hamburger

SAC Joint Venture

SEAOC: www.seaoc.org

ATC: www.atcouncil.org

CUREe: www.curee.org

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THE SAC JOINT VENTURE

SAC is a joint venture of the Structural Engineers Association of California (SEAOC), the Applied Technology Council (ATC), and California Universities for Research in Earthquake Engineering (CUREe), formed specifically to address both immediate and long-term needs related to solving performance problems with welded, steel moment-frame connections discovered following the 1994 Northridge earthquake. SEAOC is a professional organization composed of more than 3,000 practicing structural engineers in California. The volunteer efforts of SEAOC's members on various technical committees have been instrumental in the development of the earthquake design provisions contained in the *Uniform Building Code* and the 1997 *National Earthquake Hazards Reduction Program (NEHRP) Recommended Provisions for Seismic Regulations for New Buildings and Other Structures*. ATC is a nonprofit corporation founded to develop structural engineering resources and applications to mitigate the effects of natural and other hazards on the built environment. Since its inception in the early 1970s, ATC has developed the technical basis for the current model national seismic design codes for buildings; the *de-facto* national standard for postearthquake safety evaluation of buildings; nationally applicable guidelines and procedures for the identification, evaluation, and rehabilitation of seismically hazardous buildings; and other widely used procedures and data to improve structural engineering practice. CUREe is a nonprofit organization formed to promote and conduct research and educational activities related to earthquake hazard mitigation. CUREe's eight institutional members are the California Institute of Technology, Stanford University, the University of California at Berkeley, the University of California at Davis, the University of California at Irvine, the University of California at Los Angeles, the University of California at San Diego, and the University of Southern California. These university earthquake research laboratory, library, computer and faculty resources are among the most extensive in the United States. The SAC Joint Venture allows these three organizations to combine their extensive and unique resources, augmented by consultants and subcontractor universities and organizations from across the nation, into an integrated team of practitioners and researchers, uniquely qualified to solve problems related to the seismic performance of steel moment-frame structures.

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